CLAIMS

1. Selective reflective optical apparatus comprising,

a projection screen,

said projection screen having structure constructed and arranged to selectively reflect only incident optical energy of a predetermined number of narrow bands of optical wavelength regions.

2. Selective reflective optical apparatus in accordance with claim 1 wherein said structure comprises a light absorbing material having a chemical composition characterized by absorbing light energy within the region between said narrow bands.

3. Selective reflective optical apparatus in accordance with claim 1 wherein said structure comprises a light absorbing material having a chemical composition characterized by absorbing light energy within regions other than said narrow bands.

4. Selective reflective optical apparatus in accordance with claim 2 wherein said material is dye.

5. Selective reflective optical apparatus in accordance with claim 2 wherein said material is paint.

6. Selective reflective optical apparatus in accordance with claim 1 wherein said structure comprises a multilayer interference coating which reflects energy in said narrow bands while transmitting energy in the regions therebetween.

7. Selective reflective optical apparatus in accordance with claim 6 wherein said material comprises a coating constructed and arranged to absorb the transmitted energy.

8. Selective reflective optical apparatus in accordance with claim 7 wherein said coating is black.

9. Selective reflective optical apparatus in accordance with claim 1 and further comprising,

a source of projected light constructed and arranged to illuminate said projection screen,

said source providing projected light in frequency regions corresponding to said bands to effect high reflection of light from said projection screen incident from said source of projected light while absorbing high amounts of ambient light.

10. Selective reflective optical apparatus in accordance with claim 1 wherein said narrow bands are approximately blue 450-490 nm, green 540-570 nm, and red 610-650 nm.

11. Selective reflective optical apparatus in accordance with claim 1 wherein the bands are less than about 10 percent of center wavelength at full width half maximum.

12. Selective reflective optical apparatus in accordance with claim 11 wherein the bands are less than 6 percent of center wavelength.

13. Selective reflective optical apparatus in accordance with claim 6 wherein said multilayer interference coating comprises a plurality of layers of alternating low index-of-refraction and high index-of-refraction material.

14. Selective reflective optical apparatus in accordance with claim 13 wherein said low index-of-refraction material is SiO_2 and said high index-of-refraction materials are from the group consisting of TiO_2, Ta_2O_5 and Nb_2O_5.

15. Selective reflective optical apparatus in accordance with claim 13 wherein the thicknesses of the low index-of-refraction material layers are approximately 100 nm and 70 nm for the high index-of-refraction material.

16. Selective reflective optical apparatus in accordance with claim 15 wherein said multilayer interference coating has approximately 5 to 50 layers to form a coating of thickness in the range of approximately 1000 to 60000 nm.

17. Selective reflective optical apparatus in accordance with claim 1 and further comprising a diffuser on said projection screen constructed and arranged to direct the reflected light to a predetermined viewing location.

18. Selective reflective optical apparatus in accordance with claim 17 wherein said diffuser is constructed and arranged with a lenticular pattern.

19. Selective reflecting optical apparatus in accordance with claim 17 wherein said diffuser is constructed and arranged to provide asymmetric diffusion constructed and arranged to direct reflected light to a viewing region having a greater span horizontally than vertically.

20. Selective reflective optical apparatus in accordance with claim 1 and further comprising a linear polarizer on said projection screen,

said source of optical energy emitting light polarized in the same direction as said linear polarizer within said selected ranges.

21. Selective reflective optical apparatus in accordance with claim 1 wherein said projection screen is constructed and arranged to selectively reflect only incident optical energy of a predetermined number of narrow bands of optical wavelength regions and significantly attenuate reflection of incident optical energy in bands of optical wavelength regions outside the frequency ranges contained in said predetermined number of narrow bands.

22. Selective reflective optical apparatus in accordance with claim 21 wherein said projection screen structure comprises a separate absorption layer constructed and arranged to absorb incident optical energy of wavelengths outside the frequency ranges contained in said predetermined number of narrow bands of optical wavelength regions behind narrow band reflecting layers constructed and arranged to reflect incident optical energy of said predetermined number of narrow bands of optical wavelength regions.

23. Selective reflective optical apparatus in accordance with claim 21 wherein said projection screen structure comprises a multilayer interference coating of primarily transmissive layers which reflects energy in said predetermined number of narrow bands of optical wavelength regions while transmitting energy outside the frequency ranges contained in said predetermined number of narrow bands of optical wavelength regions.

24. Selective reflective optical apparatus in accordance with claim 23 wherein said structure comprises a multiplicity of absorptive layers incorporated in said multilayer interference coating.

25. Selective reflective optical apparatus in accordance with claim 23 wherein said projection screen structure comprises an absorption layer behind narrow band reflecting layers.

26. Selective reflective optical apparatus in accordance with claim 23 wherein said multilayer interference coating is constructed and arranged with relatively low reflection in the green optical wavelength for coaction with a source of projected light that radiates an excess of green light compared to other regions of the visible optical spectrum.

27. Selective reflective optical apparatus in accordance with claim 1 and further comprising,

a source of optical energy constructed and arranged to emit only light of wavelengths in said predetermined number of narrow bands of optical wavelength regions.

28. Selective reflective optical apparatus in accordance with claim 27 and further comprising,

a room embracing said source of optical energy and said projection screen having ambient lighting containing a wide band of optical wavelengths,

said projection screen constructed and arranged to significantly attenuate energy incident from said ambient lighting within said wide band of optical wavelengths but not in said predetermined number of narrow bands of optical wavelength regions.

29. Selective reflective optical apparatus in accordance with claim 27 and further comprising,

a room embracing said source of optical energy and said projection screen having ambient lighting containing a wide band of optical wavelengths but having reduced energy in said predetermined number of narrow bands of optical energy,

said projection screen constructed and arranged to significantly attenuate energy incident from said ambient lighting within said wide band of optical wavelengths but not in said predetermined number of narrow bands of optical wavelength regions.

30. Selective reflective optical apparatus in accordance with claim 21 wherein said projection screen comprises a polarizing layer polarized in a given direction.

31. Selective reflective optical apparatus in accordance with claim 30 and further comprising

a source of optical energy emitting light polarized in the same direction as that of said polarizing layer.

32. Optical apparatus comprising,

a projection screen,

a source of optical energy constructed and arranged to project light energy upon said screen in a predetermined number of narrow bands of optical wavelength regions,

a source of ambient light characterized by a wide band of optical wavelengths,

said screen constructed and arranged to significantly attenuate incident ambient light in said wide band of optical wavelengths but not in said predetermined number of narrow bands of optical wavelength regions.

33. A projection screen having at least one asymmetric diffusion layer of material enclosing oriented glass fibers constructed and arranged so that there is an index of refraction difference between the glass fibers and said material enclosing said glass fibers.

34. A projection screen having a reflective layer,

and a diffusion layer characterized by asymmetry in the z plane perpendicular to the plane of said screen such that light traveling through the diffusion layer towards the reflective layer is diffused less than the light reflected back through the diffusion layer from said reflective layer.

35. A projection screen in accordance with claim 34 wherein said diffusion layer comprises a microlens structure having a plurality of microlenses constructed and arranged

so that the shape of the microlenses are continuously varied as a function of a microlens position on the plane of the projection screen to produce said asymmetry.

36. A projection screen in accordance with claim 34 having a front face wherein said diffusion layer comprises high index-of-refraction material formed with a rough surface having bumps facing away from the projection screen front face that first accepts incident optical energy.

37. A projection screen in accordance with claim 36 and further comprising a low index-of-refraction layer bonded to said high index material.

38. A projection screen in accordance with claim 37 wherein said low index-of-refraction layer is from the group consisting of a gel and liquid.

39. A projection screen in accordance with claim 34 having a front face wherein said diffusion layer comprises a low index-of-refraction material having a rough surface with bumps facing away from the front surface of said screen that receives incident optical energy bonded to a layer of high index-of-refraction material.

40. A projection screen in accordance with claim 39 wherein said high index-of-refraction layer is from the group consisting of a gel and liquid.

41. In a screen comprised of plastic film materials and at least one adhesive, wherein some of the said plastic film materials comprise frequency selective filters, at least one adhesive and plastic film material in front of said frequency selective filters that have a property from the group of (a) low birefringence and (b) substantially uniform birefringence and oriented for maximum transmission of light of one of a desired polarization.

42. A projector light source comprising,

a first light source that emits light energy over a first relatively broad range of optical frequencies, and

a second light source constructed and arranged to emit light energy over a narrow frequency range of optical frequencies that is significantly less than said broad range.

43. A light projector in accordance with claim 42 wherein said narrow frequency range is within a region where said first light source radiates less energy compared to other frequency regions.

44. A light projector in accordance with claim 42 wherein said narrow frequency range corresponds to red.

45. A light projector in accordance with claim 42 wherein said second light source comprises a plurality of light emitting diodes.

46. A light projector in accordance with claim 42 wherein said second source comprises a filtered tungsten filament bulb.

47. A light projection system comprising,

a source of polarized light characterized by polarization of light energy in a predetermined number of narrow frequency regions in a first direction and of light energy in the frequency regions between said narrow frequency regions in a second direction,

a screen having a polarizer constructed and arranged so that light energy in said narrow frequency regions is reflected and in other frequency regions is at least partially absorbed.

48. A projection system in accordance with claim 47 wherein said projection screen comprises a multilayer interference coating.

49. A projection system in accordance with claim 47 wherein said projection screen comprises phase retarders.

50. A projection system in accordance with claim 43 wherein said source of polarized light comprises phase retarders.

51. Selective reflective optical apparatus in accordance with claim 6 wherein said coating is deposited bidirectionally in pairs of high and low index-of-refraction materials.

52. Selective reflective optical apparatus in accordance with claim 9 wherein said source of projected light comprises a digital-micromirror-device projector providing three primary

colors and a polarization recovery system constructed and arranged to provide high light throughput while making the three primary colors polarized.

53. Selective reflective optical apparatus in accordance with claim 9 wherein said source of projected light comprises a liquid-crystal-on-silicon projector providing three primary colors having the same polarization.

54. Selective reflective optical apparatus in accordance with claim 1 wherein said projection screen structure is constructed and arranged to reduce the reflection in the range of 430 to 450 nm.

55. Selective reflective optical apparatus in accordance with claim 54 wherein said projection screen structure is constructed and arranged to reduce the reflection substantially at 436 nm.

56. Selective reflective optical apparatus in accordance with claim 1 wherein said projection screen structure is constructed and arranged to change the spectral shape of the reflected light to keep the proper ambient color.

57. Selective reflective optical apparatus in accordance with claim 6 wherein said coating is nonuniform constructed and arranged so that each position on the screen has a preshifted coating that compensates for the angle of incidence of light at that position.

58. Selective reflective optical apparatus in accordance with claim 1 wherein said projection screen is curved so that the angle of incidence of light upon the screen is nearly constant.

59. Selective reflective optical apparatus in accordance with claim 6 wherein said coating comprises an interference coating on a second substrate that was transferred from a first substrate.

60. Selective reflective optical apparatus in accordance with claim 9 wherein said ambient light is filtered to remove light in said predetermined number of narrow bands.

61. Selective reflective optical apparatus in accordance with claim 60 wherein said source of ambient light comprises a filtered bulb.

62. Selective reflective optical apparatus in accordance with claim 9 wherein said source of projected light is constructed and arranged to also furnish ambient light having spectral components outside said predetermined number of narrow bands.

63. Selective reflective optical apparatus in accordance with claim 1 wherein said narrow bands, when combined, provide a visible full color spectrum.

64. Selective reflective optical apparatus in accordance with claim 9 where the wavelength ranges of said narrow bands are optimized for non-UHP bulbs in the associated projector.

65. Selective reflective optical apparatus in accordance with claim 9 wherein the reflectiveness of said narrow bands varies from band to band to compensate for varying output levels of said source of projected light in said corresponding frequency regions.

66. Optical apparatus comprising,

a projection screen,

a source of optical energy constructed and arranged to project light energy upon said screen in a predetermined number of narrow bands of optical wavelength regions,

a source of ambient light characterized by a wide band of optical wavelengths but having reduced energy ins aid predetermined number of narrow bands of optical energy,

said screen constructed and arranged to significantly attenuate incident ambient light in said wide band of optical wavelengths but not in said predetermined number of narrow bands of optical wavelength regions.

67. Selective reflective optical apparatus in accordance with claim 56 wherein said change is a reduction of the green reflection.

68. Selective reflective optical apparatus in accordance with claim 60 wherein window tinting or a film attached to or placed in front of windows provides said filtered ambient light.